THE PLASMA DYNAMIC SYNTHESIS OF ALUMINUM NITRIDE WITH USING OF COAXIAL MAGNETO PLASMA ACCELERATOR[1]

I. I. SHANENKOV, A.A. SIVKOV**, YU.L. SHANENKOVA**, A.S. IVASHUTENKO***

**634050 Lenina av. 30,Tomsk, Russia, Swordi@list.ru, +7(906)-956-1366*
***634050 Lenina av. 30,Tomsk, Russia*

Aluminum nitride was firstly synthesized in 1877, but only in the late of 20th century this material attracted the attention of scientists due to a number of its unique properties. The high thermal conductivity, low coefficient of thermal expansion, thermal stability, low dielectric constant, non-toxic, high mechanical strength make it one of the most important materials for the manufacture of ceramics [1-3]. To date, there are many different ways to obtain this material [4].

It is known that synthesis by plasma methods has such advantages as the fast speed of reaction due to the high plasma temperature (~ 10^4 K), the possibility of obtaining ultrafine monocrystalline product due to the high cooling rate (> 10^6 K / s) and the possibility of using precursors without special pre-treatment [5]. The obtaining of ultrafine aluminum nitride powders can be realized by plasma dynamic method in systems based on coaxial magneto plasma accelerator (CMPA) with using different precursors.

The series of experiments has been carried out with using of aluminum central electrode and barrel-electrode in nitrogen atmosphere and in argon atmosphere using melamine as nitrogen-containing precursor and in nitrogen atmosphere with melamine. Synthesized products have been analyzed by such methods as X-ray diffractometry (XRD) using Shimadzu XRD 7000S diffractometer and transmission electron microscopy (TEM) using Philips CM30 microscope.

It was found that the product with the highest content of aluminum nitride is obtained in experiments with using of melamine and nitrogen atmosphere. The possibility of synthesis aluminum nitride in hyper speed plasma jet is confirmed by the results of TEM analysis. It is clearly seen that the synthesized product consists of well-crystalized monoparticles predominantly with sizes of 60-120 nm (figure 1).

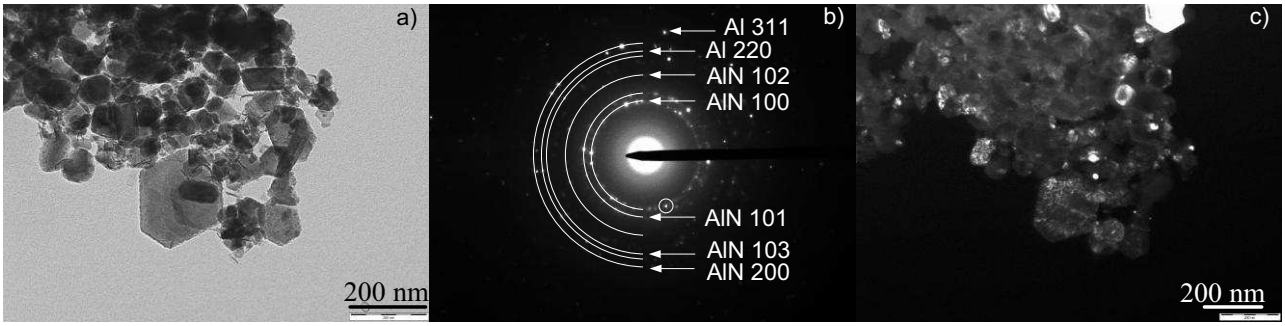

Fig. 1. TEM-images of synthesized product: a) bright-field image; b) SAED; c) dark-field image

Thus, the present results indicate the possibility of synthesis of aluminum nitride in the system based on coaxial magneto plasma accelerator, using both gaseous and solid precursors.

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